

**Approval Standard**

**for**

**Pipe Hanger Components**

**for**

**Automatic Sprinkler Systems**

**Class Numbers 1951, 1952, and 1953**

September 2003

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# Foreword

FM Approvals are intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of FM Approval Standards is to present the criteria for FM Approval of various types of products and services, as guidance for FM Approvals personnel, manufacturers, users and authorities having jurisdiction.

Products submitted for Approval shall demonstrate that they meet the intent of the Approval Standard, and that quality control in manufacturing and/or applications shall ensure a consistently uniform and reliable product or service. FM Approval Standards strive to be performance-oriented and to facilitate technological development.

For examining equipment, materials and services, FM Approval Standards:

- a) must be useful to the ends of property conservation by preventing, limiting or not causing damage under the conditions stated by the Approval listing; and
- b) must be readily identifiable.

Continuance of Approval and Listing depends on compliance with the Approval agreement, satisfactory performance in the field, on successful re-examinations of equipment, materials, and services as appropriate, and on periodic follow-up audits of the manufacturing facility or service/application.

FM Approvals LLC reserves the right in its sole judgement to change or revise its standards, criteria, methods, or procedures.

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## I INTRODUCTION

### 1.1 Purpose

- 1.1.1 This standard states FM Approval criteria for pipe hanger components used in automatic sprinkler systems.
- 1.1.2 FM Approval criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a follow-up audit program.

### 1.2 Scope

- 1.2.1 This standard encompasses the design and performance requirements for pipe hanger components used in automatic sprinkler systems. Appendix D illustrates various sprinkler pipe hanger components, and is intended to serve as a guide to consistent use of nomenclature for the examination and listings. In cases where metric sized pipe hanger components are to be examined for Approval, test loads comparable to the English equivalent shall be used.
- 1.2.2 Pipe hangers encompassed by this standard are designed to support  $\frac{3}{4}$ , 1, 1 $\frac{1}{4}$ , 1 $\frac{1}{2}$ , 2, 2 $\frac{1}{2}$ , 3, 3 $\frac{1}{2}$ , 4, 5, 6, 8, 10, and 12 in. (20, 25, 32, 40, 50, 65, 80, 90, 100, 125, 150, 200, 250, and 300 mm) nominal pipe sizes.
- 1.2.3 FM Approval standards are intended to verify that the product described will meet stated conditions of performance, safety, and quality useful to the ends of property conservation.
- 1.2.4 Pipe Hanger Types — Some of the common types of sprinkler pipe hanger components covered by this standard are:

<u>Pipe Support Components</u>	<u>Building Attached Components</u>
Eye Rods	C-Type Clamps
U-Type Hangers	Cantilever Brackets
Swivel Hangers	Channel Clamps
Clevis Hangers	I-Beam Clamps
Hinge Hangers	Screw Clips
Ring Hangers	Ceiling Flanges
Steel Band Hangers	Angle Brackets
	Expansion Shields
	Concrete Inserts
	Trapeze Hangers
	Tipping Dowels

- 1.2.5 Other types of hanger components may be Approved if they meet the requirements and intent of this standard. Components of unusual design may be subjected to special tests to determine their suitability.

### 1.3 Basis for Requirements

- 1.3.1 The requirements of this standard are based on experience, research and testing, and/or the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists was also considered.

1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of pipe hanger components for the purpose of obtaining FM Approval. Pipe hanger components having characteristics not anticipated by this standard may be Approved if performance equal, or superior, to that required by this standard is demonstrated, or if the intent of the standard is met. Alternatively, pipe hanger components which meet all of the requirements identified in this standard may not be Approved if other conditions which adversely affect performance exist or if the intent of this standard is not met.

#### 1.4 Basis for FM Approval

FM Approval is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

1.4.1 Examination and tests on production samples shall be performed to evaluate:

- the suitability of the product
- the performance of the product as specified by the manufacturer and required by FM Approvals; and as far as practical,
- the durability and reliability of the product.

1.4.2 An examination of the manufacturing facilities and audit of quality control procedures shall be made to evaluate the manufacturer's ability to produce the product which was examined and tested, and the marking procedures used to identify the product. These examinations are repeated as part of FM Approvals' product follow-up program.

#### 1.5 Basis for Continued Approval

Continued Approval is based upon:

- production or availability of the product as currently Approved;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated in the Master Agreement;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory Facilities and Procedures Audits (F&PAs) conducted as part of FM Approvals' product follow-up program.

Also, as a condition of retaining Approval, manufacturers may not change a product or service without prior authorization by FM Approvals.

## 1.6 Effective Date

The effective date of an Approval Standard mandates that all products tested for Approval after the effective date shall satisfy the requirements of that standard. Products Approved under a previous edition shall comply with the new version by the effective date or forfeit Approval.

The effective date of this Standard is September 30, 2004 for compliance with all requirements.

## 1.7 System of Units

Units of measurement used in this standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Appendix A lists the selected units and conversions to SI units for measures appearing in this standard. Conversion of U.S. customary units is in accordance with the American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)/American Society for Testing Materials (ASTM) SI 10-97, "Standard for Use of the International System of Units (SI): The Modern Metric System."

## 1.8 Applicable Documents

The following standards, test methods, and practices are referenced in this standard:

ANSI/IEEE/ASTM SI 10-97, *Standard for Use of the International System of Units (SI): The Modern Metric System*

ASTM A6/A6M-02b, *Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling*

ASTM A653/A653M-02, A635/A635M-02, *Standard Specification for General Requirements for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Commercial Steel, Drawing Steel, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, Hot-Rolled*

ASTM A924/A924M-99, *Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process*

ASTM B-117-02, *Practice for Operating Salt Spray (Fog) Apparatus*

FM Global Property Loss Prevention Data Sheets

International Organization for Standardization (ISO) 3575:1996, *Continuous Hot-Dip Zinc-Coated Carbon Steel Sheet of Commercial, Lock-Forming and Drawing Qualities*

ISO 4998:1996, *Continuous Hot-Dip Zinc-Coated Carbon Steel Sheet of Structural Quality*

Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS), SP-69-02, *Pipe Hangers and Supports — Selection and Application*

## 1.9 Definitions

For purposes of this standard, the following terms apply:

### ***Accepted***

This term refers to installations acceptable to the authority enforcing the applicable installation rules. When the authority is FM Global, such locations are termed “FM Global Accepted.” Acceptance is based upon an overall evaluation of the installation. Factors other than the use of FM Approved equipment impact upon the decision to accept, or not to accept. Acceptance is not a characteristic of a product. It is installation specific. A product accepted for one installation may not be acceptable elsewhere. (Contrast with FM Approved.)

### ***Adjustable Swivel Band Hanger***

A type of band hanger that is adjustable and swivels.

### ***Approval Mark***

The FM Approval Mark is detailed in Appendix B. Its use is mandatory on all units of Approved products. These registered marks cannot be used except as authorized by FM Approvals via the granting of Approval to a specific product.

### ***Band Hanger***

A type of hanger that is adjustable and utilizes a band looped around the pipe.

### ***Bracket***

A cantilever-type hanger that is attached directly to a vertical surface of the building structure.

### ***Building Attached Component***

A hanger part that is attached directly to a building structural element.

### ***“C” Clamp***

A hanger that grips a flange by means of a jaw and setscrew combination.

### ***Ceiling Flange***

A hanger that is attached directly to an overhead surface of a building structure.

### ***Clamp***

A hanger part that is rigidly attached to the flange of a steel structural member.

### ***Beam Clamp***

A clamp that is rigidly attached to both edges of the bottom flange of a structural member.

### ***Top or Bottom Beam Clamp***

A clamp that is rigidly attached to one edge of the top or bottom flange of a structural member.

### ***Clamp (Riser)***

A type of pipe clamp used to support risers at various levels.

***Clevis Hanger***

A type of split ring hanger.

***Clip***

A pipe support, usually one piece and non-adjustable, that only partially embraces a pipe and that may be attached directly to a building structure.

***Concrete Insert***

Inserts installed in the freshly poured concrete as the building is constructed.

***Coupling***

A hanger part used to connect expansion shields or fasteners to a rod. Couplings may have male or female threads and may have a straight or reducing pattern.

***Driven Fastener***

A hanger that is driven into concrete or steel by use of a special tool, usually powder-actuated. Fasteners may have male or female threads.

***Expansion Shell (Case, Shield, or Base)***

A hanger that is inserted into a self-drilled or predrilled hole in concrete and then “set”, usually by tightening of a bolt, setting of a cam or semisoft member, or forced expansion over a hardened steel plug.

***Fasteners***

Anchors, expansion shields, concrete inserts, explosive-driven fasteners and threaded head screws that provide anchorage to building structural members for supporting pipe hangers. For vertical installation only.

***FM Approved***

This term refers to products Approved by FM Approvals. Such products are listed in the *Approval Guide*, a publication of FM Approvals, issued annually, or one of its supplements. All products so listed have been successfully examined by FM Approvals, and their manufacturers have signed and returned a Master Agreement to FM Approvals. This form obligates the manufacturer to allow re-examination of the product and audit of facilities and procedures at FM Approvals’ discretion. It further requires the manufacturer not to deviate from the as-Approved configuration of the product without review by and agreement of FM Approvals. Approval is product and site specific.

***Hanger***

A unit assembly used singly or in combination with other assemblies for supporting or hanging pipe.

***Non-Heat Sensitive Material***

A material whose measured tensile strength at 1005 °F ± 50 °F (540 ± 10°C) is at least 90 percent of the value measured at 68 °F ± 41°F (20 °C ± 5 °C).

***Retaining Strap***

A hanger part used to hold a hanger in its intended position, usually on a beam.



**Ring**

A pipe hanger that completely encircles a pipe without a positive gripping action.

**Solid Ring**

A ring that has to be slipped onto the end of the pipe and cannot be opened in any way for attachment to the pipe after the pipe line is made up.

**Split Ring**

A ring that can be opened in some way to allow it to be put on the pipe after the pipe line is made up.

**Swivel Ring**

A solid or split ring that has a top swivel allowing the hanger to be connected to a rod after it has been installed on the pipe.

**Screw**

Threaded head screws used to provide anchorage to concrete, steel or wood building structural members for supporting pipe hangers.

**Trapeze Hanger**

A building attached component that attaches to the rib width underside of a structural steel deck.

**Tipping Dowel**

A building attached component that inserts into the rib width opening of a structural steel deck.

## 2. GENERAL INFORMATION

### 2.1 Product Information

2.1.1 A pipe hanger usually consists of two or more components combined to make a functional assembly. One part of a hanger attaches to a structural element of the building and another part supports the pipe. Pipe hangers encompassed by this standard are used to support overhead piping in an automatic sprinkler system. Complete hanger assemblies or individual components may be tested for Approval. Installation shall be in accordance with FM Global Property Loss Prevention Data Sheet 2-8N and the manufacturer's installation instructions.

2.1.2 Pipe hanger components shall be examined on a type-by-type, manufacturer-by-manufacturer, and plant-by-plant basis. This is predicated on the basis that identical products, produced with identical materials by different manufacturers, or even by different plants of the same manufacturer, have been seen to perform differently in testing. Sample pipe hanger components, selected in conformance to this criterion, shall satisfy all of the requirements of this standard.

## 2.2 Approval Application Requirements

To apply for an Approval examination the manufacturer, or its authorized representative, should submit a written request to:

Hydraulics Group Manager  
FM Approvals Hydraulics Laboratory  
743A Reynolds Road  
West Glocester, RI 02814  
U.S.A.

The manufacturer shall provide the following preliminary information with any request for Approval consideration:

- a complete list of all models, types, sizes, and options for the products or services being submitted for Approval consideration,
- general assembly drawings, complete set of manufacturing drawings, materials list(s) and material specifications (such as ASTM A48 CL 40 — Cast Iron), anticipated marking format, brochures, sales literature, specification sheets, installation, operation and maintenance procedures, etc; and,
- the number and location of manufacturing facilities.

All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All foreign language documents shall be provided with English translation.

## 2.3 Requirements for Samples for Examination

Following set-up and authorization of an Approval examination, the manufacturer shall submit samples for examination and testing. Sample requirements are to be determined by FM Approvals following review of the preliminary information. Sample requirements may vary depending on formulation features and results of prior testing. It is the manufacturer's responsibility to submit samples representative of production. Any decision to use data generated utilizing prototypes is at the discretion of FM Approvals. The manufacturer's test facilities may be used for testing. If testing is performed at the FM Approvals Hydraulics Laboratory, it is the manufacturer's responsibility to provide any necessary test fixtures, such as those which may be required to evaluate the pipe hanger components. Any manufacturer's supplied test fixtures shall be returned to the manufacturer at their request.

### 3. GENERAL REQUIREMENTS

#### 3.1 Review of Documentation

During the initial investigation and prior to physical testing, the manufacturer's specifications, technical data sheets, and design details shall be reviewed to assess the ease and practicality of installation and use. The product shall be capable of being used within the limits of the Approval investigation.

#### 3.2 Physical or Structural Features

##### 3.2.1 Pipe Support Components

Pipe support components shall have adequate strength to support the maximum length of water filled pipe expected in sprinkler system installations plus a safety factor to account for the effects of shock, vibration, or unanticipated loading. The test loads which will be applied to verify adequate strength of these components are shown in Table 3.2.1.

**Table 3.2.1**  
**Pipe Support Component Test and Pre-Loads**

<i>Nominal Pipe Size</i>		<i>Pre-Load</i>		<i>Test Load</i>	
<i>NPS (in.)</i>	<i>(DN [mm])</i>	<i>Lbf</i>	<i>(N)</i>	<i>Lbf</i>	<i>(N)</i>
3/4	(20)	20	(89)	340	(1512)
1	(25)	30	(133)	410	(1824)
1 1/4	(32)	45	(200)	430	(1913)
1 1/2	(40)	55	(245)	520	(2313)
2	(50)	80	(356)	635	(2825)
2 1/2	(65)	120	(534)	940	(4181)
3	(80)	175	(778)	1060	(4715)
3 1/2	(90)	200	(890)	1255	(5583)
4	(100)	250	(1112)	1475	(6561)
5	(125)	350	(1557)	2000	(8896)
6	(150)	475	(2113)	2615	(11 632)
8	(200)	750	(3336)	3800	(16 903)
10	(250)	1120	(4982)	5855	(26 044)
12	(300)	1530	(6808)	7900	(35 141)

##### 3.2.2 Building Attached Components

Building attached components shall provide a secure connection to a building structural element and shall have sufficient strength to support sprinkler system piping in accordance with the rod size and pipe size combinations shown in Table 3.2.2. The test loads, also shown in Table 3.2.2, will be applied to verify adequate strength.

**Table 3.2.2 Building Attached Component Test and Pre-Loads**

<i>Nominal Pipe Size</i>		<i>Rod Size</i>		<i>Pre-Load</i>		<i>Test Load</i>	
<i>NPS</i> <i>(in.)</i>	<i>(DN [mm])</i>	<i>in.</i>	<i>(Metric)</i>	<i>Lbf</i>	<i>(N)</i>	<i>Lbf</i>	<i>(N)</i>
¾ - 4	(20 - 100)	⅜	(M10)	250	(1112)	1475	(6561)
5, 6, 8	(125, 150, 200)	½	(M12)	750	(3336)	3800	(16 903)
10, 12	(250, 300)	⅝	(M16)	1530	(6808)	7900	(35 141)

### 3.3 Design Requirements

#### 3.3.1 General

- A. To provide adequate durability, any ferrous metal part that is ⅛ in. (3.18 mm) thick or less shall be plated with a non-ferrous material to at least 0.0005 in. (0.0127 mm) thickness or otherwise coated, to a recognized national or international standard, to retard oxidation of the base material. Coatings shall withstand the effects of shipping, assembly and installation, weathering and corrosion.
- B. Sprinkler pipe hangers shall be substantially supported from the building structure and designed to support five times the weight of the water filled Schedule 40 steel pipe plus 250 lbs (113 kg) at each point of piping support. The distance between hangers is 12 ft (3.6 m) for ¾ through 1¼ in. nominal pipe sizes and 15 ft (4.6 m) for larger pipe sizes.

#### 3.3.2 Couplings

- A. Couplings are sometimes required to connect expansion shields or powder-driven fasteners to other hanger components. Couplings may be of the straight or reducing type. Standard thread sizes are listed in Table 3.3.2.

**Table 3.3.2 Coupling Standard Thread Sizes**

<i>Straight</i>		<i>Reducing</i>	
<i>in.</i>	<i>(Metric)</i>	<i>in.</i>	<i>(Metric)</i>
⅜ × ⅜	(M10 × M10)	⅜ × ½	(M10 × M12)
½ × ½	(M12 × M12)	½ × ⅝	(M12 × M16)
⅝ × ⅝	(M16 × M16)	⅝ × ¾	(M16 × M20)
¾ × ¾	(M20 × M20)	¾ × ⅞	(M20 × M22)

- B. When couplings are used with a hanger component or as part of a hanger assembly, they shall be tested in accordance with the test loads shown in Table 3.2.2, based on the largest threaded connection.

Couplings shall not be used to adapt another pipe hanger component in such a manner as to violate the minimum rod sizes of Table 3.2.2. Except when used as part of an expansion shield or powder-driven fastener rated for the load of the pipe being supported, coupling shall be used only to adapt larger threaded building-attached components to smaller threaded pipe support components, and never the converse.

#### 3.3.3 Pipe Support Components

- A. Test loads are designed to support five times the weight of the water filled Schedule 40 steel pipe plus 250 lbs (113 kg) at each point of piping support with the maximum distance between hangers of 12 ft (3.6 m) for ¾ (20 mm) through 1¼ in. (32 mm) pipe sizes and 15 ft (4.6 m) for larger pipe sizes.
- B. Hanger components are usually interconnected by threaded steel rods. Approved components shall be threaded to accept the appropriate rod size. Pipe size vs. rod size combinations shall be as shown in Table 3.2.2. Rod sizes shall not be less than those shown in the tables; however, components designed for larger rod sizes are acceptable.

3.3.4 Building Attached Components

- A. Building attached components shall have sufficient strength to support the test loads assigned without failure. Before application of the test loads shown in Table 3.2.2, the components will first be pre-loaded in accordance with Table 4.2.2 to take up any slack between parts.
- B. To prevent slippage, any elongation observed during testing of a beam or C-type clamp, or other similar product, shall require the manufacturer to provide retainer straps, or other equivalent means of securing the component to the structural member.

3.3.5 Threaded Components

- A. Hanger components are usually interconnected by threaded steel rods. Approved components shall be threaded to accept the appropriate rod size. Minimum rod sizes for each pipe size shall be as shown in Table 3.3.5a. However, components designed for larger rod sizes can be Approved. Hanger rods alone shall not be considered for Approval.

**Table 3.3.5a Minimum Rod Sizes**

<i>Nominal Pipe Size</i>		<i>Rod Size</i>	
<i>NPS (in.)</i>	<i>DN [mm]</i>	<i>in.</i>	<i>(Metric)</i>
¾ - 4	(20 - 100)	¾	(M10)
5, 6, 8	(125, 150, 200)	½	(M12)
10, 12	(250, 300)	⅝	(M16)

- B. To avoid possible loosening due to vibration or other long term conditions, standard hexagonal jam nuts shall be used to secure cup point set screws to building attached components.
- C. To ensure adequate strength and long term durability, threaded fastening components used in sprinkler system pipe hangers shall have a threaded engagement length of at least the diameter of the connecting member. Threaded components shall have a minimum applied torque as specified in Table 3.3.5b.

**Table 3.3.5b Minimum Recommended Torque**

<i>Thread Size</i>		<i>Minimum Torque</i>	
<i>in.</i>	<i>(Metric)</i>	<i>lbf·in.</i>	<i>(N·m)</i>
¼	(M6)	40	(5)
⅕	(M8)	50	(6)
⅜	(M10)	60	(7)
7/16	(M11)	90	(10)
½	(M12)	125	(14)
9/16	(M14)	180	(20)
⅝	(M16)	250	(28)
¾	(M19)	400	(45)
7/8	(M22)	665	(75)
1	(M25)	990	(112)

- D. Expansion shields, screws and concrete inserts may be threaded either externally or internally.
- E. Threads shall be in accordance with the national or international recognized standard of the intended market for the component.

### 3.3.6 Connections to Steel Deck

Connection of the pipe hangers shall be to the building structural framing.

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#### EXCEPTION

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Connection to the floor or roof steel deck shall be permitted when the following conditions apply:

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3.3.6.1 Where the construction practices in some countries have spacing between building structural framing that immediately supports the steel deck, and exceeds the maximum allowable branch line hanger spacing.

3.3.6.2 Pipe hangers such as Trapeze, Tipping Dowel, etc., for branch lines up to nominal 3 in. (80 mm) in pipe size shall be permitted and attached to steel decking under the following conditions\*:

- The hangers are Approved for use in steel decking and are installed in accordance with the “Manufacturer’s Installation Instructions”, which shall include steel deck types and minimum thickness, and subject to any limitations specified by the FM Global Property Loss Prevention Data Sheets and the FM Approval Report.
- The structural design of the decking shall consider the weight of the water-filled pipe (for both wet- and dry-systems) plus dead, live and collateral loads (e.g., suspended ceilings or other items hung from the steel deck). This comment, as well as a statement that it is the responsibility of the sprinkler system designer to certify and include structural design details with submitted plans, shall be included in the “Manufacturer’s Installation Instructions”.
- A positive means of connection and engagement to the steel deck shall be provided, and will not loosen under normal cycles of steel deck deflection.

**Note:** \* This does not apply to deck material other than steel, nor to the crossmain of feedmain sprinkler piping.

3.3.6.3 The test samples shall be installed on a section of the steel deck of minimum thickness acceptable, in accordance with the “Manufacturer’s Installation Instructions.” Test loads shall be applied in tension along the axis of the threaded rod.

## 3.4 Materials

Common materials used in hanger components are malleable iron, ductile iron, rolled steel, and heat treated steel. These and any other materials used in hanger components shall have physical properties necessary to render them suitable for their intended use. When unusual materials are used, special tests may be necessary to verify their suitability.

## 3.5 Markings

3.5.1 Marking on the product shall include the following information:

- name and address of the manufacturer or marking traceable to the manufacturer;
- identifying model or part number;
- the maximum pipe size or the hanger rod size used with the component; and,
- FM Approved Mark, (see Appendix B).

3.5.2 The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the product as FM Approved. The manufacturer shall not place this model or type identification on any other product unless covered by a separate report.

3.5.3 Products which cannot be completely marked due to their size shall have complete identification on the smallest size shipping container, including the complete name and address of the manufacturer.

3.5.4 The FM Approved Mark (see Appendix B) shall be displayed visibly and permanently on the product and/or packaging as appropriate. The manufacturer shall not use this mark on any other product unless such product is covered by separate Approval Report with FM Approvals.

3.5.5 Pipe hanger components that are produced at more than one location shall be identified as the product of a particular location.

3.5.6 All markings shall be legible and durable.

### **3.6 Manufacturer's Installation and Operation Instructions**

Installation instructions, including any special dimensional, orientation or torque requirements, shall be furnished by the manufacturer. Instructions shall be provided in each shipping container or attached to each major component.

### **3.7 Calibration**

All examinations and tests performed in evaluation to this standard shall use calibrated measuring instruments traceable and certified to acceptable national standards.

## **4. PERFORMANCE REQUIREMENTS**

### **4.1 Examination**

#### **4.1.1 Requirement**

The pipe hanger components shall conform to the manufacturer's drawings and specifications and to FM Approvals requirements.

#### **4.1.2 Test/Verification**

The samples shall be examined and compared to drawings and specifications. It shall be verified that the sample conforms to the physical and structural requirements described in Section 3, General Requirements.

## 4.2 Tensile Tests

### 4.2.1 Requirements

- 4.2.1.1 Building attached components shall have sufficient strength to support the required load and no component shall fail, slip and/or elongate more than  $\frac{3}{16}$  in. (4.76 mm) between application of the pre-load and the minimum required test load, as shown in Table 3.2.2. An exception is a beam or C-clamp, or similar device, without a retainer strap (see Appendix D), where any elongation would lead to failure.

All size Beam and C-clamp types shall be tested on an ASTM Standard A6/A6M-90a, W8X24 “W” shapes beam, under load, in positions with load on and opposite the set screw side, unless specified by the manufacturer for one position. Other beams will be tested on a case-by-case basis if deemed necessary by the manufacturer’s installation instructions.

- A. Testing of building attached components to C- or Z-shaped steel secondary roof members shall be on the minimum allowable thickness of roof members per the manufacturer’s installation instructions. Tested components shall be assembled, installed, and adjusted as specified in the manufacturer’s instructions. Attachment of hanger components to the flanges of C-shaped purlins is not permitted. There shall be no visual physical damage to the roof members at the minimum required load.

Installation of these building attached components to Z-shaped purlins at the vertical web midpoint is highly advisable. (Alternatively for Z-shaped purlins, attachment may be to the bottom flange, at a point as close to the web as possible, but at a distance from the web no further than  $\frac{1}{2}$  of the flange width.) In no case should purlin stiffeners be used as the point of attachment. Any clamp-type hangers used on Z-shaped purlins with flange stiffeners shall be the type which will not contact the flange stiffener, such as the large flange C-clamp shown at the top center of Appendix E, *Attachment Locations for Hangers with C-shaped or Z-shaped Purlins*. For C-shaped purlins attachment shall only be to the vertical web at midpoint.

- B. Concrete inserts, screws and expansion shields shall be tested using minimum  $10 \times 10 \times 6$  in. ( $254 \times 254 \times 152$  mm) reinforced concrete blocks which have been aged for at least thirty days. Blocks shall have a compressive strength of 2,500 to 3,000 psi (17.24 to 20.68 mPa), see Appendix F. Tested components shall be assembled, installed, and adjusted as specified in the manufacturer’s instructions.

- 4.2.1.2 Steel Deck Attachment Components may be Approved for branch lines up to nominal 3 in. (80 mm) in size. They shall have sufficient strength to support the required load and no component shall fail, slip and/or elongate more than  $\frac{3}{16}$  in. (4.76 mm) between application of the pre-load as defined in Table 4.3 and the minimum required test load, as defined in Table 3.2.2. Tested components shall be assembled, installed, and adjusted as specified in the manufacturer’s instructions. Hangers for use on steel decking shall be tensile tested on the minimum allowable thickness of steel decking per the manufacturer’s installation instructions. There shall be no visual physical damage to the steel decking at the minimum required load.

- 4.2.1.3 Other pipe hanger and pipe support components shall have sufficient strength to support the required load and no component shall fail or elongate more than  $\frac{3}{16}$  in. (4.76 mm) between application of the pre-load and the minimum required test load, Table 3.2.1. Tested components shall be assembled, installed, and adjusted as specified in the manufacturer’s instructions.



4.2.2 Tests/Verification

Building Attached, Pipe Hanger, Pipe Support, and Steel Deck Attachment Components shall be installed in a tensile test machine (See Appendix C) having sufficient strength to support the required load and no component shall fail, slip and/or elongate more than  $\frac{3}{16}$  in. (4.76 mm) between application of the pre-load and the minimum required test load. Fixed reference points shall be set to zero after the pre-load is reached. The test load shall be maintained for one minute before the final observation and elongation measurement is made. Loads beyond the required minimum shall then be applied to determine the ultimate failure point of the component. A tensile testing machine shall be used to produce the desired load. Threaded components shall have a minimum applied torque before application of the tensile load as specified in Table 3.3.5b.

For building or steel deck attached pipe hanger components, the manufacturer shall provide three minimum thickness steel secondary roof members or steel deck samples for each size of pipe hanger rod along with all hanger installation components to be tested. A steel mounting jig/plate measuring no more than 21 x 21 inches ( 533 x 533 mm), with four  $\frac{3}{8}$  inch (11 mm) mounting holes, centered and spaced exactly  $3\frac{1}{2}$  x 11 inch (89.9 x 279.4 mm) on the jig/plate, shall be provided by the manufacturer. The minimum thickness steel secondary roof members or steel deck samples shall be prepared and provided, by the manufacturer, with the mounting hardware for attachment to the jig/plate.

**Table 4.2.1 Pipe Hanger Component Pre-Loads**

<i>Nominal Pipe Size</i>		<i>Pre-Load</i>		<i>Test Load</i>	
<i>NPS (in.)</i>	<i>(DN [mm])</i>	<i>lbf</i>	<i>(N)</i>	<i>Lbf</i>	<i>(N)</i>
$\frac{3}{4}$	(20)	20	(89)	340	(1512)
1	(25)	30	(133)	410	(1824)
$1\frac{1}{4}$	(32)	45	(200)	430	(1913)
$1\frac{1}{2}$	(40)	55	(245)	520	(2313)
2	(50)	80	(356)	635	(2825)
$2\frac{1}{2}$	(65)	120	(534)	940	(4181)
3	(80)	175	(778)	1060	(4715)
$3\frac{1}{2}$	(90)	200	(890)	1255	(5583)
4	(100)	250	(1112)	1475	(6561)
5	(125)	350	(1557)	2000	(8896)
6	(150)	475	(2113)	2615	(11 632)
8	(200)	750	(3336)	3800	(16 903)
10	(250)	1120	(4982)	5855	(26 044)
12	(300)	1530	(6808)	7900	(35 141)

**Table 4.2.2 Building Attachment Pre-Loads**

<i>Nominal Pipe Size</i>		<i>Pre-Load</i>		<i>Test Load</i>		<i>Minimum Rod Size</i>	
<i>NPS (in.)</i>	<i>(DN [mm])</i>	<i>lbf</i>	<i>(N)</i>	<i>lbf</i>	<i>(N)</i>	<i>in.</i>	<i>(Metric)</i>
¾ - 4	20 - 100	250	(1112)	1475	(6 561)	¾	(M10)
5, 6, 8	125, 150, 200	750	(3336)	3800	(16 903)	½	(M12)
10, 12	250, 300	1530	(6808)	7900	(35 141)	⅝	(M16)

### 4.3 Coating Evaluation

#### 4.3.1 Requirement

To provide adequate durability, ferrous metal parts 1/8 in. (3.2 mm) thick or less shall be plated with a nonferrous material to a minimum 0.0005 in. (0.013 mm) thickness or otherwise coated to retard oxidation of the base material. Coatings shall withstand the effect of shipping, assembly, and installation. All corrosion-resistant coatings shall be visually inspected for continuity, adhesion, and durability. Thickness of corrosion-resistant coatings shall be measured by means of sectioning of sample components and microscopic examination of the cross-section in as many areas as judged necessary after review of each part. Corrosion resistant specifications shall be submitted for review.

#### 4.3.2 Test/Verification

Any discontinuous coatings shall be evaluated by subjecting three samples of the component to a 20 percent salt spray (fog) environment as specified by ASTM B117-2002, Practice for Operating Salt Spray (Fog) Apparatus, for a duration of 10 days. After exposure, the samples shall be allowed to dry for a period of two to four days. At the conclusion of the test, the corrosion resistant coating shall not have lifted, or otherwise increased the exposure area of the unprotected base material of the component. The effect of coating degradation as a result of this test shall be established by subjecting the exposed components to tensile testing. Results for these tests shall meet the requirements of Section 4.2, Tensile Tests.

The effect of coating degradation as a result of this test shall be established by subjecting the exposed components to tensile testing. Results for these tests shall meet the requirements of Section 4.2, Tensile Tests.

### 4.4 Mechanical Locking

#### 4.4.1 Requirement

All components which depend on spring-loaded engagements, loose interlocking engagement fits, and other non-positive locked assembly features shall be evaluated by appropriate impact, vibration, and displacement tests.

#### 4.4.2 Test/Verification

Compliance shall be verified by tests of a minimum of one sample of each type appropriate to the hanger component under examination. The hanger component shall be subjected to the vibration sequence of Table 4.4.2. The plane of vibration shall be vertical. The pull test of Section 4.2, as applicable, shall be repeated after the vibration test of each sample assembly. No failure shall be observed.

*Table 4.4.2 Vibration Conditions*

<i>Total Stroke</i>		<i>Frequency</i>	<i>Time</i>
<i>in.</i>	<i>(mm)</i>	<i>Hz</i>	<i>hours</i>
0.020	(0.51)	28	5
0.040	(1.04)	28	5
0.150	(3.81)	28	5
0.040	(1.04)	*18 to 37 (variable)	5
0.070	(1.78)	*18 to 37 (variable)	5

\* Two Cycles Per Minute

**4.5 Additional Tests**

Additional tests may be required, including fire tests, impact test, etc., depending on design features, results of any tests, material application, or to verify the integrity and reliability of the pipe hangers, at the discretion of FM Approvals.

Unexplainable failures shall not be permitted. A re-test shall only be acceptable at the discretion of FM Approvals and with adequate technical justification of the conditions and reasons for failure.

**5. OPERATIONS REQUIREMENTS**

A quality control program is required to assure that subsequent pipe hanger components produced by the manufacturer at an authorized location shall present the same quality and reliability as the specific pipe hanger components examined. Design quality, conformance to design, and performance are the areas of primary concern. Design quality is determined during the Approval examination and tests, and is covered in the Approval Report. Conformance to design is verified by control of quality and is covered in the Facilities and Procedures Audit (F&PA). Quality of performance is determined by field performances and by periodic re-examination and testing.

**5.1 Demonstrated Quality Control Program**

5.1.1 The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:

- existence of corporate quality assurance guidelines;
- incoming quality assurance, including testing;
- in-process quality assurance, including testing;
- final inspection and tests;
- equipment calibration;
- drawing and change control;
- packaging and shipping; and,
- handling and disposition of non-conformance materials.

In order to assure traceability of materials and products, the manufacturer shall maintain records of all certificates of materials and quality control tests performed for a minimum period of two years from the date of manufacture.

#### 5.1.2 Documentation/Manual

There should be an authoritative collection of procedures/policies. It should provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system should require that sufficient records are maintained to demonstrate achievement of the required quality and verify operation of the quality system.

#### 5.1.3 Records

To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.

#### 5.1.4 Drawing and Change Control

- The manufacturer shall establish a system of product configuration control that shall allow no unauthorized changes to the product. Changes to critical documents, identified in the Approval Report, shall be reported to, and authorized by, FM Approvals prior to implementation for production.
- The manufacturer shall assign an appropriate person or group to be responsible for, and require that, proposed changes to Approved or Listed products be reported to FM Approvals before implementation. The manufacturer shall notify FM Approvals of changes in the product or of persons responsible for keeping FM Approvals advised by means of FM Approvals Form 797, *Approved Product Revision Report or Address/Contact Change Notice*.
- Records of all revisions to all Approved products shall be maintained.

### 5.2 Facilities and Procedures Audit (F&PA)

- 5.2.1 An audit of the manufacturing facility is part of the Approval investigation to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to insure a uniform product consistent with that which was tested and Approved.
- 5.2.2 These audits shall be conducted periodically but at least annually by FM Approvals or its representatives or more frequently dependent on jurisdictional requirements. At issue of this standard the Occupational and Safety Health Administration (OSHA) of the United States Department of Labor requires audits of manufacturing sites producing products for use in hazardous locations during each quarter the product is manufactured.
- 5.2.3 FM Approved products or services shall be produced or provided at or from the location(s) audited by FM Approvals and as specified in the Approval Report. Manufacture of products bearing the FM Approval Mark is not permitted at any other location without prior written authorization by FM Approvals.

### 5.3 Manufacturer's Responsibilities

- 5.3.1 The manufacturer shall notify FM Approvals of changes in product construction, design, components, raw materials, physical characteristics, coatings, component formulation or quality assurance procedures prior to implementation of such changes.
- 5.3.2 Approved pipe hanger components shall be produced under production controls adequate to maintain quality within the parameter of the design.

5.3.3 Where all or part of the quality control has been subcontracted, the manufacturer shall, at a minimum, conduct sufficient oversight audits to verify the continued application of the required controls.

#### **5.4 Manufacturing and Production Tests**

##### *5.4.1 Test Requirement No. 1 — Material Composition*

Composition of materials shall be verified by vendor certifications. The chemical or physical properties that are critical to the functioning of the item shall be sample tested. Testing shall be performed by the manufacturer or, on their behalf, by an agency independent of the vendor. Testing shall be conducted at a minimum of once a year.

##### *5.4.2 Test Requirement No. 2 — Dimensional Checks*

The manufacturer shall measure and record critical component dimensions, material thickness, markings, and threaded connections (as applicable) at the beginning of each production run. Thereafter, these measurements shall be recorded every 4 hours. The number of samples to be measured shall be based on the manufacturer's Quality Control Manual, but in no case shall be less than five samples. Measurements shall be compared to the latest revision of the component drawings.

## APPENDIX A UNITS OF MEASUREMENT

<b>AREA:</b>	$\text{in}^2$ — “square inches”; ( $\text{mm}^2$ — “square millimeters”) $\text{mm}^2 = \text{in}^2 \times 6.4516 \times 10^2$ $\text{ft}^2$ — “square feet”; ( $\text{m}^2$ — “square meters”) $\text{m}^2 = \text{ft}^2 \times 0.0929$
<b>FORCE:</b>	$\text{lb}$ — “pounds”; ( $\text{N}$ — “Newtons”) $\text{N} = \text{lb} \times 4.4482$
<b>LENGTH:</b>	$\text{in.}$ - “inches”; ( $\text{mm}$ — “millimeters”) $\text{mm} = \text{in.} \times 25.4$ $\text{ft}$ — “feet”; ( $\text{m}$ — “meters”) $\text{m} = \text{ft} \times 0.3048$
<b>MASS:</b>	$\text{lb}$ — “pounds”; ( $\text{kg}$ — “kilograms”) $\text{kg} = \text{lb} \times 0.454$
<b>STRESS:*</b>	$\text{psi}$ — “pounds per square inch”; ( $\text{kPa}$ — “kilopascals”) ( $\text{mPa}$ — “megapascals”) $\text{KPa} = \text{psi} \times 6.895$ $\text{mPa} = \text{psi} \times 0.00689$
<b>TEMPERATURE:</b>	$^{\circ}\text{F}$ — “degrees Fahrenheit”; ( $^{\circ}\text{C}$ — “degrees Celsius”) $^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times 0.556$

\* Also strength and pressure

## APPENDIX B APPROVAL MARKS

### REPRODUCTION ART: FM Approval Marks

**For use on nameplates, in literature, advertisements,  
packaging and other graphics.**



- 1) The FM Approvals diamond mark is acceptable to FM Approvals as an Approval mark when used with the word "Approved."
- 2) The FM Approval logomark has no minimum size requirement, but should always be large enough to be readily identifiable.
- 3) Color should be black on a light background or a reverse may be used on a dark background.

#### For Cast-On Marks



- 4) Where reproduction of the mark described above is impossible because of production restrictions, a modified version of the diamond is suggested. Minimum size specifications are the same as for printed marks. Use of the word "Approved" with this mark is optional.

NOTE: These Approval marks are to be used only in conjunction with products or services that have been FM Approved. The FM Approval marks should never be used in any manner (including advertising, sales or promotional purposes) that could suggest or imply FM Approval or endorsement of a specific manufacturer or distributor. Nor should it be implied that Approval extends to a product or service not covered by written agreement with FM Approvals. The Approval marks signify that products or services have met certain requirements as reported by FM Approvals.

Additional reproduction art is available through

FM Approvals  
P.O. Box 9102,  
Norwood, Massachusetts 02062  
U.S.A.

### APPENDIX C SAMPLE TESTS CONFIGURATIONS

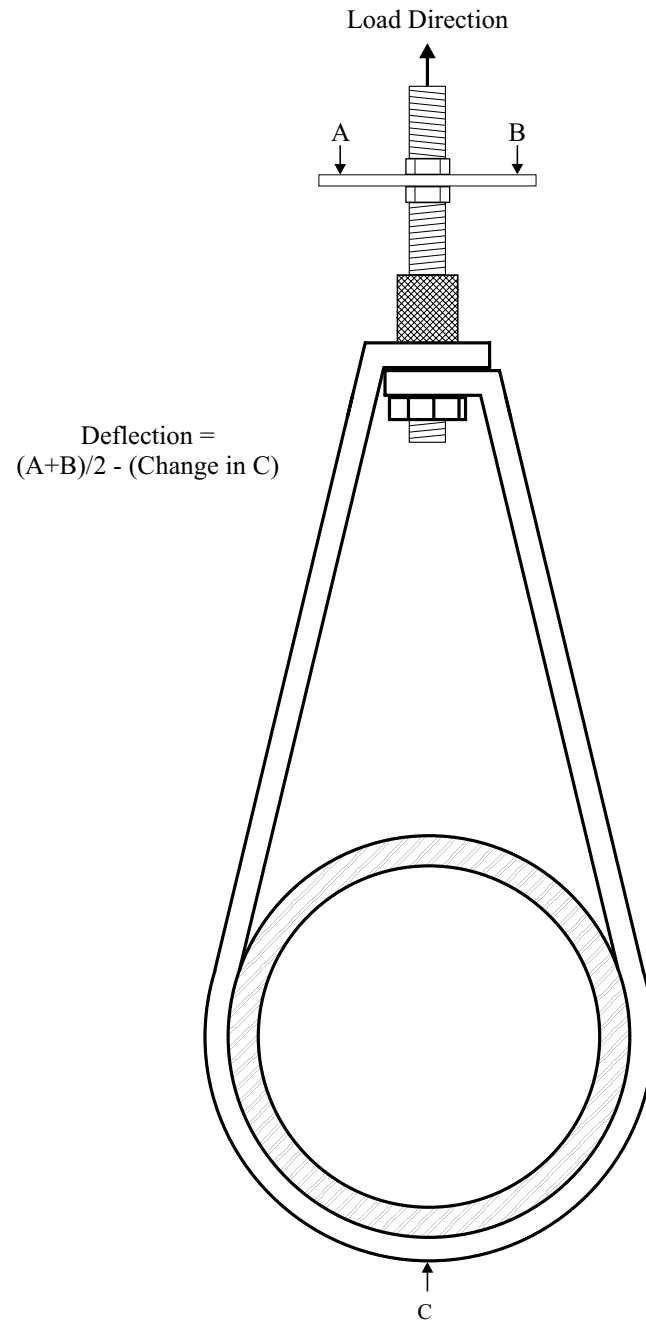


Figure 1. Loop Hanger



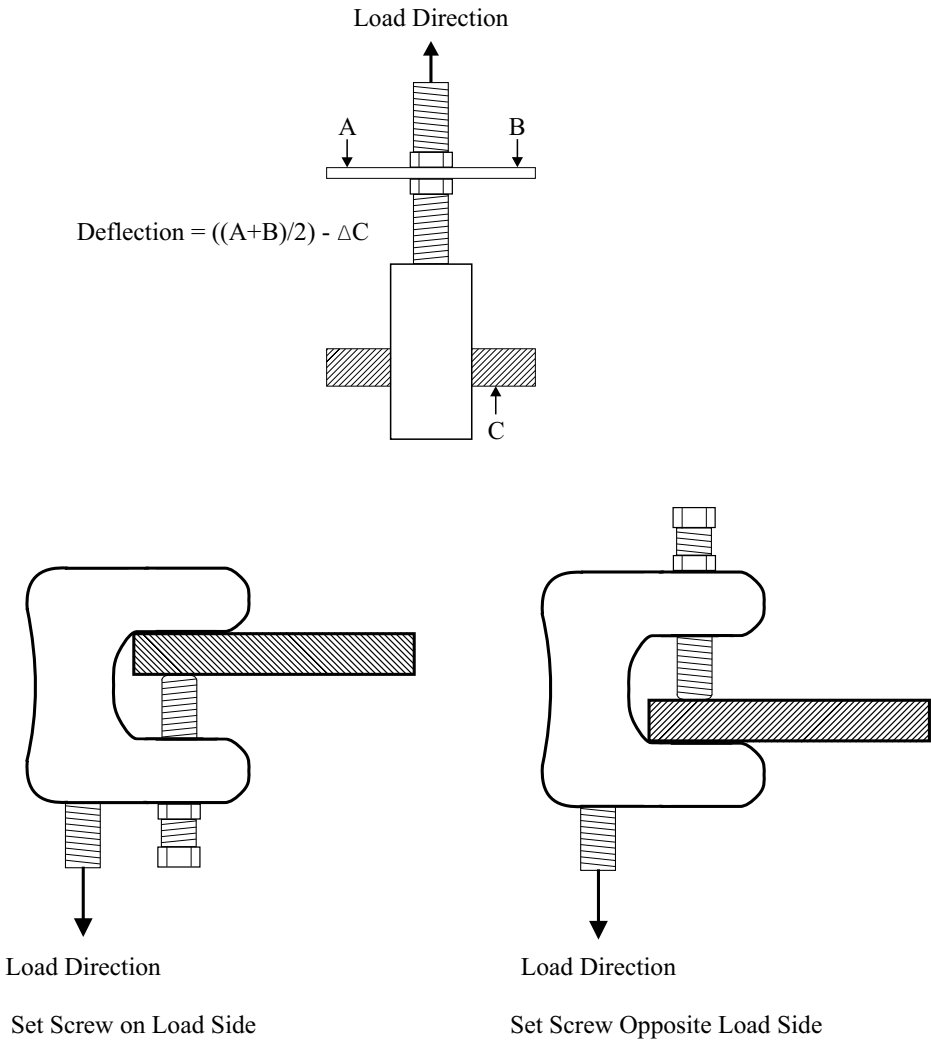
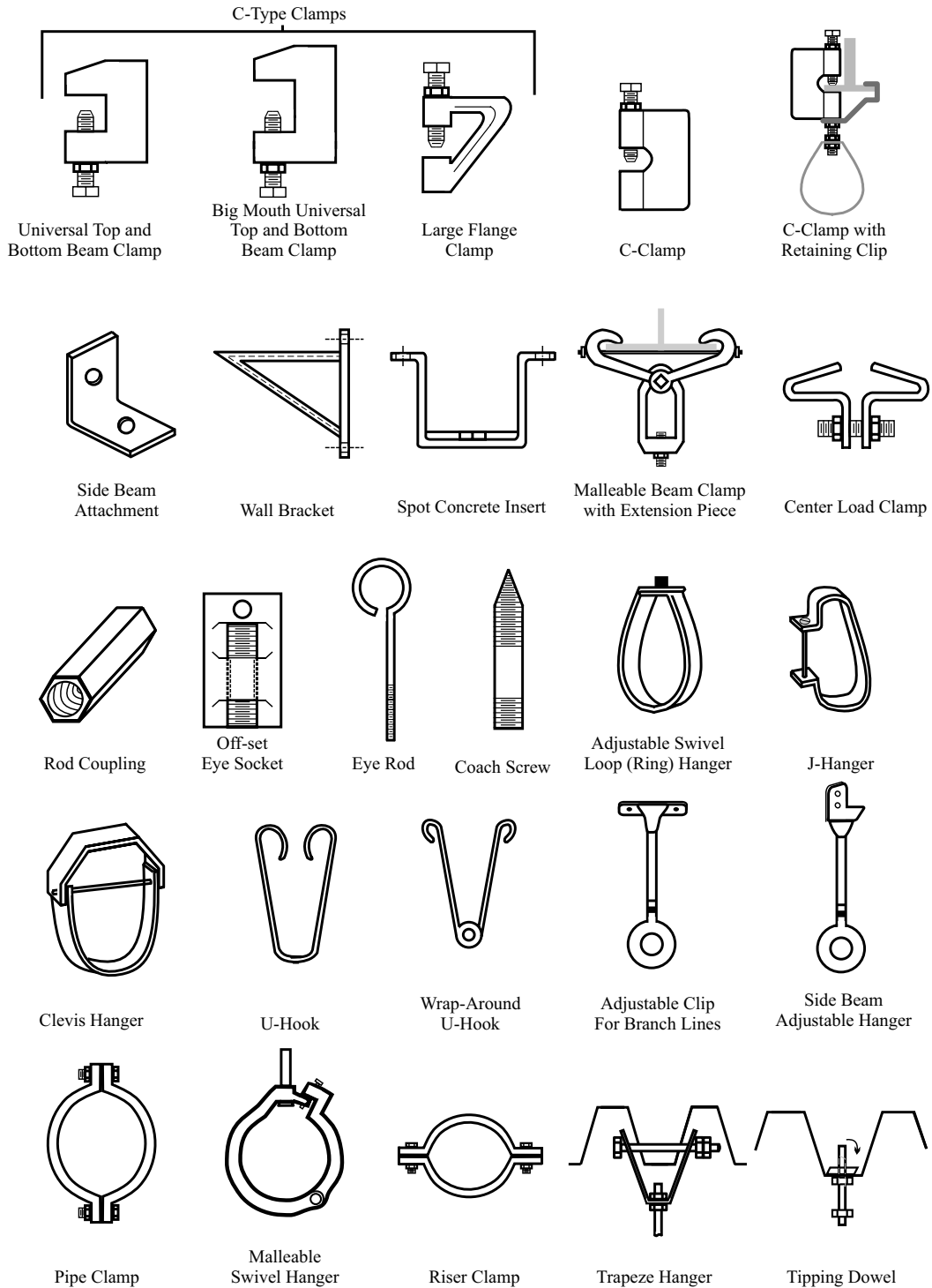
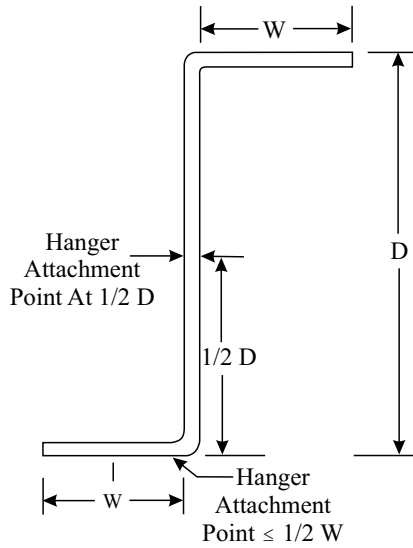


Figure 2. Beam Clamp

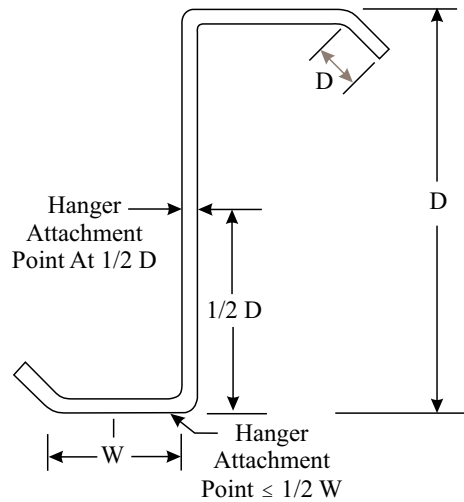
## APPENDIX D TYPICAL HANGER TYPES



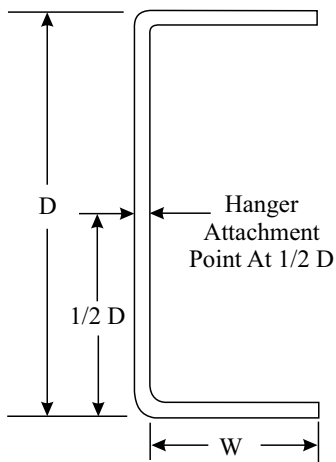
**APPENDIX E  
ATTACHMENT LOCATIONS FOR HANGERS  
WITH C-SHAPED OR Z-SHAPED PURLINS**



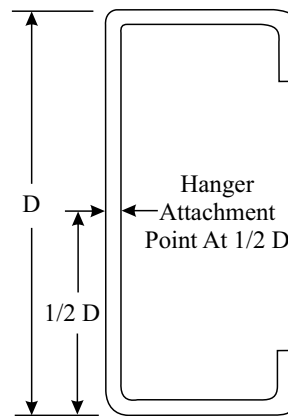
Z Purlin Without Flange (Edge) Stiffeners



Z Purlin With Flange (Edge) Stiffeners

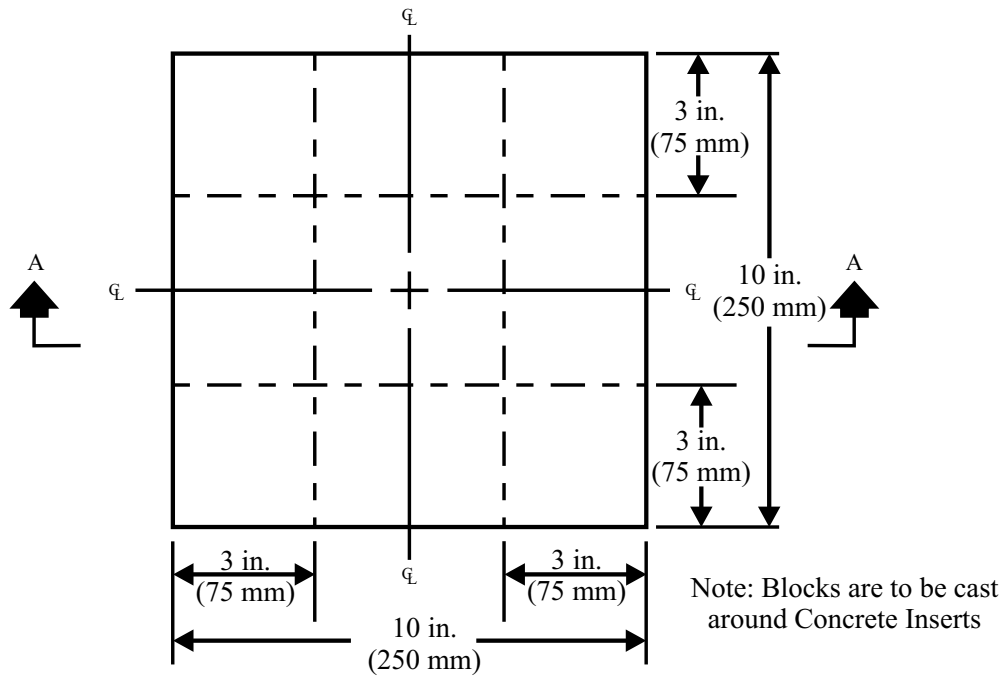
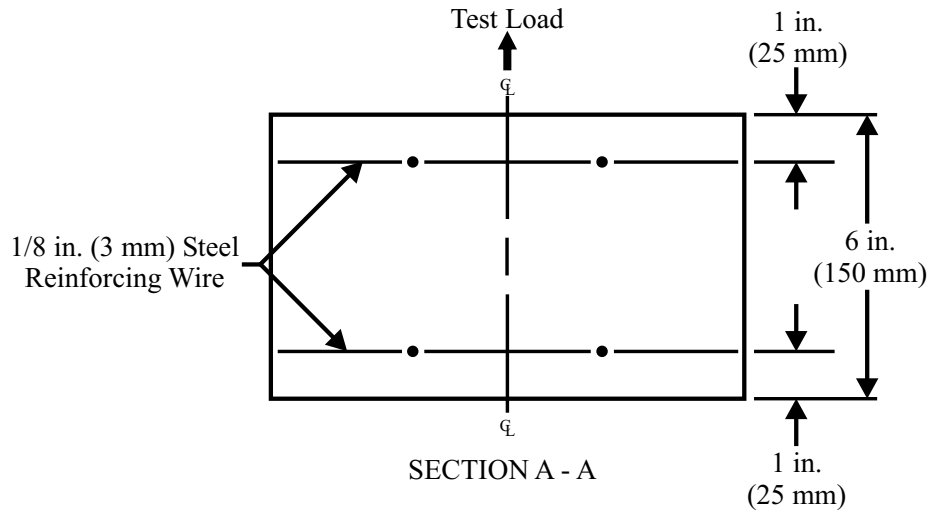


C Purlin Without Flange (Edge) Stiffeners



C Purlin With Flange (Edge) Stiffeners

**APPENDIX F  
CONCRETE BLOCK FOR TENSILE TESTS**



## APPENDIX G SAMPLE LISTING

<i>Product Designation</i>	<i>Component Description</i>	<i>Nominal Rod Size, in. (mm)</i>	<i>Nominal Pipe Size, in.</i>	<i>Remarks</i>
XYZ	Ring Pipe Hanger	3/8 (10)	3/4 through 4	
123	Wide Throat Beam Clamp #	1/2 (12)	5 through 8	With Retainer Clamp
ABC123*	Sleeve Anchor	5/8 (16)	10, 12	
XYZ321	Threaded Head Screw	3/8 (10)	3/4 through 4	For Use in Steel Only
123ABC	Concrete Insert	1/2 (12)	5 through 8	With Model 123 Nut

\* Available in 316 Stainless Steel

# Installation limited with set-screw on load side.